

AGROFORESTRY APPENDIX

Other countries:

India

Chhabra Soil Salinity and Water Quality Chapter Grasses and Trees as Alternate Strategies.

Table 17: Relative tolerance of tree species to alkali soil conditions

Alkali condition	pH/ESP range	Tree species (scientific name)
High	9.5-10.0 ESP 25-50	Mesquite (<i>Prosopis juliflora</i>)
		Acacia (<i>Acacia nilotica</i>)
		Casuarina (<i>Casuarina equisetifolia</i>)
Medium	9.0-9.5 ESP 15-25	Eucalyptus (<i>Eucalyptus tereticornis</i>)
		Alvizia (<i>Albizia lebbek</i>)
		Alvizia (<i>Albizia falcata</i>)
		Pongamia (<i>Pongamia pinnata</i>)
		Arjun (<i>Ternubakua arjuna</i>)
		Sesbania (<i>Sesbania aegyptica</i>)
Low	8.5-9.0 ESP < 15	Zizphus (<i>Zizphus jujuba</i>)
		Parkinsonia (<i>Parkinsonia aculeate</i>)
		Azadirachta (<i>Azadirachta exotica</i>)
		Azadirachta (<i>Azadirachta indica</i>)
		Tamarind (<i>Tamarindus indica</i>)
		Shisham (<i>Dalbergia sissoo</i>)
		Mulberry (<i>Morus alba</i>)

The table is based on work in India in 1970 by Yadav and Singh conducted in the Vrij Bhumi Forest Division of Uttar Pradesh. All species failed to grow on soils where the pH was above 10 and salts were above 3.42%¹¹ (43 dS/m) in the top 15 cm. *Prosopis juliflora* could tolerate pH up to 10 and salts up to 1% (12.5 dS/m). Irrigation was apparently with good quality water and the statement is made "physical removal of salts is of great help, especially in the first year, can be useful." Most of the trees were sensitive to excess water in the rootzone; temporary waterlogging can kill young plants.

In a section on the afforestation of saline soils – choice of species. Chhabra (1996) reports that on dry ClSO_4^{2-} solonchaks of Israel (EC_e varying between 12 and 17 dS/m) *Eucalyptus camaldulensis* and *Pinus helepensis* were found to be the most tolerant trees planted. Also, in other research *Tamarix ramosissima* and *Terminalia tetrandia* could root successfully in horizons that contained up to six per cent salt. Others trees, which have been successful in saline conditions are: *Acacia nilotica*, *Albizia lebbek*,

¹¹ 1% concentration is 10,000 ppm; If this is TDS (total dissolved solids) division by 800 will approximate the EC in dS/m. Thus, 1% salt is approximately 12.5 dS/m.

Parkinsonia aculeate, *Prosopis sicigera* and *Zisypus jujuba*. Where the combination of high salinity and shallow water table exist together *Casuarina equisetifolia*, *Tamarix articulata* and *Prosopis juliflora* have been found to perform well. Chhabra also reports that Tomar and Gupta (1986) reported that *A. nilotica*, *A. tortillas*, *A. auriculiformis*, *C. equisetifolia* and *E. camaldulensis* can be successfully grown in moderate salinity 10-22 dS/m.

Related work reported Minhas, P.S., O.P. Sharma and S.G. Patil (eds), (1998) 25 years of research on management of salt affected soils and use of saline water in agriculture, Central soil salinity research institute, Karnal, India Printed at Yugantar Prikashan, New Delhi.

Chapter 9, Tomar, O.S. and S.G. Patil, (1998) Alternative land uses

The areas of India with salt lands exist in arid, semi-arid and hot sub-humid regions. Young plants may suffer injuries from frost during winter. 70-80% of total rainfall in July- September, but it is very erratic. Irrigation water is not available for afforestation so it is important to utilize poorer quality water. Irrigation water used EC 12-29 dS/m causes some reduction in biomass on *Acacia nilotica* and *Prosopis juliflora*. They may use as little as 10% of open pan evaporation.

Suitably grown in Gangawati province (22 species of trees on sodic vertisols) were *P. juliflora*, *A. nilotica*, *Cassia siamea*, *Albizia lebbeck*, *Azadirachta indica* and *E. tereticornis*. *C. equisetifolia* and *Acacia auriculiformis* did not survive due to prevailing high temperatures and non-availability of irrigation water. On alluvial sodic soil at Kanpur *A. nilotica* and *P. juliflora* were better than *Eucalyptus* spp. and *Casuarina equisetifolia*. (pH 10.1-10.4, EC_e 4.8 –5.6 dS/m, ESP 74.5 –79.3)

Results of a study at Sampala, Tomar found on highly saline, water logged soil *Prosopis juliflora*, *Acacia nilotica*, *A. farnesiana*, *A. tortillas*, *Casuarina glauca*, *Parkinsonia aculeate* and *Tamarix* sp. were suitable.

Table 18: Salt tolerance in water logged condition of some firewood tree species

Salinity levels of satisfactory growth takes place (EC_e dS/m)	Tree species
Promising (>25)	<i>Acacia farnesiana</i> , <i>Parkinsonia aculeate</i> , <i>Prosopis juliflora</i> , <i>Salvadora persica</i> , <i>S. oleoides</i> and <i>Tamarix</i> sp.
Moderately Promising (15-25)	<i>Acacia nilotica</i> , <i>C. glauca</i> 13987, <i>C. glauca</i> 13144, <i>C. obesa</i> 27, <i>C. equisetifolia</i>
Moderately sensitive (5-15)	<i>A. tortilis</i> , <i>A. pennatula</i> , <i>Callistemon lanceolatus</i> , <i>Eucalyptus camaldulensis</i> , <i>E. tereticornis</i> , <i>Leucaena leucocephala</i> , <i>Pithecellobium dulce</i> , <i>Pongamia pinnata</i> , <i>Terminalia arjuna</i>
Sensitive (<5)	Not listed – no value to drainage water reuse.

Israel

Pasternak and Nerd (1996) report on experimental work with halophytes at a site 8 km south of Ashkelon. Tree and other crops were irrigated in some plots with seawater (54 dS/m) and in control plots with 15% seawater (9 dS/m). The only trees which performed better in the 100% seawater and did better the second year than the first year were: *Tamarix aphylla*, *Casuarina glauca*, *Casuarina stricta*¹², and *Melaleuca halmaturorum*. Trees that did well in the fifteen percent seawater were *Eucalyptus sargentii*, *Tamarix articulata*, *T. chinensis*, *T. juniperina* (Mapu), *T. nilotica*, *T. tetragonya*, *T. tetragoniodes*, *T. implexicoma*, *Prosopis nigra* and *P. pallida*.

The writers recommend all the *Tamarix*, *Eucalyptus sargentii*, and *Melaleuca halmaturorum* for use as landscape trees where irrigation may be with seawater, but do not list *Casuarina* or explain why this species was left from their list.

In the Negev, Paternak and Nerd (1996) recommend the following salt tolerant, heat tolerant and drought tolerant trees for planting. *Casuarina glauca*, *C. stricta* (good for windbreaks), *Acacia horrida* (good thorns for an outer boundary for plantations), *Prosopis alba*, *P. juliflora*, *P. nigra*, *Eucalyptus spathulata* (small, very attractive), *E. torquata* (medium size –hardy- very attractive flowers), *E. lanceolata*, *Salvadora persica* (likes a warm climate –very hardy), and a small, decorative, flowering tree, *Moringaceae oleifera*. The *Prosopis* were labeled as, multipurpose trees – highly recommended.

¹² *Casuarina stricta* has apparently been renamed *Allocasuarina verticillata* (Lam.) (drooping sheoak). The Australian book, Trees for the saltland, states that it tolerates wind, frost, drought, water logging and moderate salinity.